

Scleractinian coral (Cnidaria, Hexacorallia, Scleractinia) diversity of the Mersing Islands, Peninsular Malaysia

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Academic editor: James Reimer | Received 14 February 2022 | Accepted 20 April 2022 | Published 20 May 2022

<http://zoobank.org/ABA3ED30-4521-4A5F-8939-2BAE25E4793A>

Citation: Lee JN, Adzis KAA, Afiq-Rosli L, Tanzil JTI, Chan AA, Ismail MN, Akmal KF, Affendi YA (2022) Scleractinian coral (Cnidaria, Hexacorallia, Scleractinia) diversity of the Mersing Islands, Peninsular Malaysia. ZooKeys 1102: 177–190. <https://doi.org/10.3897/zookeys.1102.82228>

Abstract

We present a comprehensive checklist of scleractinian (hard) corals for the Mersing Islands, Malaysia based on surveys conducted at 24 reefs across protected and unprotected marine areas. A total of 261 species of corals from 16 families and one *incertae sedis* (*Pachyseris* spp.) were recorded, along with ten records that are new for the east coast of Peninsular Malaysia. Compared against the IUCN Red List, 46.7% of coral species found in the Mersing Islands were of Least Concern (LC), 29.5% as Near Threatened (NT) and 16.4% Vulnerable (V). Only one recorded species, *Pectinia maxima* (Moll & Best, 1984), was listed as Endangered (EN). Baseline species diversity data are essential for the monitoring and management of marine biodiversity, especially within marine protected areas. With both protected and unprotected coral reef areas in the vicinity of the widely scattered Mersing Islands, the diversity and distribution of coral species can be used as the basis for area-based conservation and management strategies. The diversity and abundance of scleractinian corals of each island or area should be surveyed periodically to ensure the appropriate level of protection is afforded to retain scleractinian biodiversity in this region.

Keywords

Biodiversity, conservation, hard coral, Johor, marine protected area, South China Sea

Introduction

Scleractinian corals, commonly referred to as hard corals, are a group of animals belonging to the order Scleractinia under the Phylum Cnidaria. These organisms are the backbone of coral reefs, which support high species diversity, provide goods and services (e.g., food, coastal protection, tourism), and provide substantive support to people worldwide (Praveena et al. 2012; Huang et al. 2016; Hoegh-Guldberg et al. 2019). Coral reefs in Malaysia are estimated to cover about 4,006 km² (Praveena et al. 2012), with most reefs found in Sabah and along the east coast of Peninsular Malaysia, and in limited areas in Sarawak and the west coast of Peninsular Malaysia (UNEP 2007). A total of 398 species of scleractinian corals (Huang et al. 2015) and 925 species of reef fishes (Chong et al. 2010) have thus far been recorded from the shallow fringing reefs along the coasts of Peninsular Malaysia alone. These reefs are located at Sunda Shelf, within and near the western edge of the Coral Triangle, a marine biodiversity hotspot that is home to 627 species of zooxanthellate corals (Veron et al. 2015).

Malaysia, as a megadiverse country, is dedicated to fulfilling the Convention on Biological Diversity (CDB) agreement (Tong 2020). With the launch of the National Policy on Biological Diversity in 2016, Malaysia aims to further safeguard both key terrestrial and marine ecosystems, as well as species and genetic diversity (Goal 3) (Ministry of Natural Resources and Environment 2016). Knowledge and data on the biodiversity of Malaysia's vast marine areas will therefore be crucial for stakeholders and policy makers to identify suitable areas for ecological protection. To date, studies that have reported on the reef-building coral biodiversity around Peninsular Malaysia are somewhat limited. A review by Affendi and Rosman (2011) found only six research articles on scleractinian diversity published for the coral reef-rich areas along the east coast of Peninsular Malaysia, most of which were based on surveys conducted only around highly visited tourist islands that are under the jurisdiction of the Department of Fisheries Malaysia (DOF), e.g., Pulau Redang and Pulau Tioman (e.g., Toda et al. 2007; Akmal et al. 2019).

The Mersing Islands comprise one of the largest archipelagos off the east coast of Peninsular Malaysia. With 58 islands (Said et al. 2021), this region is not only known for its coral reefs but also for its seagrass ecosystems (Ooi et al. 2011; Ponnampalam et al. 2015). Geologically, the Mersing Islands originated ~350 million years ago, and they are currently evaluated as a potential National Geopark for their unique geological and cultural heritage (Said et al. 2021). This elevated status will not only affect the islands but also the surrounding marine life, both in terms of increased protection and increased tourism. Biodiversity data in the area will therefore be extremely valuable to advise any development and/or management plans for the Mersing Islands. A sole report that recorded 155 species of scleractinian corals from four islands (Pulau Dayang, Pulau Pemanggil, Pulau Tinggi

and Batu Tikus) (Harborne et al. 2000) was the main literature source for coral biodiversity in the Mersing Islands prior to this study, aims to provide a comprehensive updated species checklist of scleractinian corals for the coral reefs around the Mersing Islands.

Methods

The study area comprised islands on the east coast of Johor, Peninsular Malaysia, referred to as the Mersing Islands. Underwater surveys were carried out during two expeditions, one in 2012 (“Marine Park Biodiversity Expedition”) and one in 2016 (“Johor 8 Islands Expedition”). Parts of the Mersing Islands (Fig. 1) are protected under the unique overlapping protection by both Malaysia’s Federal (known as Johor Marine Park) and Johor State jurisdictions, i.e., these reefs are protected under the Fisheries Act of 1985 (Federal) as well as by the Johor State government, following the establishment of the Johor National Park in 1990. Both authorities promote the protection, preservation and management of the natural breeding ground and habitat of aquatic life. In 2013, the protected area that falls within Mersing Islands was renamed ‘Sultan Iskandar Marine Park’, and entrance and activities within the Marine Park are strictly controlled by Johor National Park Corporation, leading to a significant reduction of tourism activities in the area (Hassan 2013).

Coral species diversity surveys were conducted at Pulau Aur, Pulau Pemanggil, Pulau Besar, Pulau Sibul and Pulau Tinggi (Fig. 1) in 2012, when a total of 13 reefs were surveyed (depth range: 3–12 m) using 100 m transects perpendicular to the shoreline, for a total of 19 transects. Further surveys were conducted in 2016 for one reef at Pulau Tinggi using SCUBA timed swims (English et al. 1997), and seven reefs via transects perpendicular to the shoreline (Pulau Lima Kecil, Pulau Lima Besar, Pulau Tokong Rakit, Tokong Gantang, Tokong Chondong, Tokong Belalai and Tokong Chupak) (Fig. 1). The reefs surveyed in 2012 were all part of a larger marine protected area (MPA), whereas the reefs surveyed in 2016 were all outside the MPA (i.e., unprotected, non-MPA).

Corals were identified to species level based on distinct features of their morphological structure according to Veron (2000), using photographs and videos recorded during the survey. All identified species were standardized according to the World Register of Marine Species (Hoeksema and Cairns 2021) to account for synonyms and taxonomic change. The relative abundance and conservation status of each species were gathered from Veron (2000) and the IUCN Red List (IUCN 2019). Conservation categories that were used are Not Evaluated (NE), Data Deficient (DD), Least Concern (CC), Near Threatened (NT), Vulnerable (VU), Endangered (EN) and Critically Endangered (CR).

Results

A total of 261 scleractinian coral species from 16 families and one *incertae sedis* were recorded during the 2012 (MPA; 243 species) and 2016 (non-MPA; 261 species)

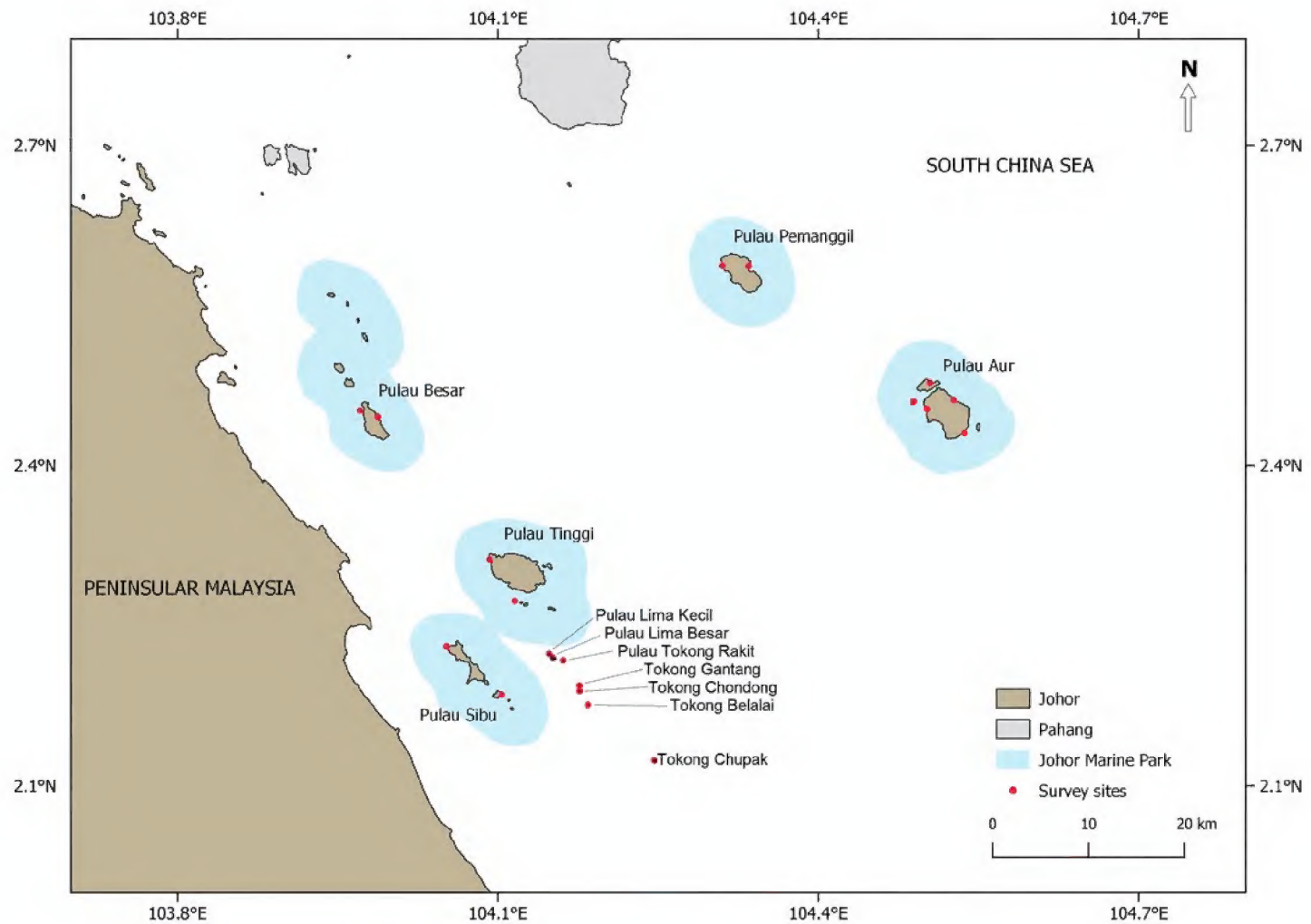


Figure 1. Survey areas at the Mersing Islands. Johor Marine Park protected area are two nautical miles away from the low tide shoreline of each gazetted island

expeditions. Table 1 shows the checklist of scleractinian corals from Mersing Islands, with species arranged alphabetically by family and including records (155 species) from the previous survey published by Harborne et al. (2000). The current study found ten new records of scleractinian corals from the Mersing Islands in the larger Peninsular Malaysia east coast area (Fig. 1), i.e. *Acropora pectinata* (Brook, 1892); *Astreopora explanata* Veron, 1985; *Coeloseris mayeri* Vaughan, 1918; *Halomitra pileus* (Linnaeus, 1758); *Acanthastrea rotundoflora* Chevalier, 1975; *Favites vasta* (Klunzinger, 1879); *Paramontastraea serageldini* (Veron, 2000); *Seriatopora hystrix* Dana, 1846; *Goniopora gracilis* (Milne Edwards & Haime, 1849); and *Pavona divaricata* Lamarck, 1816 (Fig. 2).

Of the 16 families recorded, Acroporidae was the richest with a total of 79 species: 39 *Acropora* species, 28 *Montipora* species and four from other genera (Table 1). Six per cent (16) of species from the list were considered ‘rare’ in abundance according to Veron (2000), whereby the species can be common in a specific area but rare overall. According to the IUCN Red List, many coral species we observed were classified as of Least Concern (46.7%), Near Threatened (29.5%) or Vulnerable (18.8%). Only one species, *Pectinia maxima*, was categorised as Endangered (EN). The remaining species were Not Evaluated (3.8%) or classified as Data Deficient (0.8%).

Table 1. Checklist of scleractinian corals from the Mersing Islands according to (a) Harborne et al. (2000); (b) Marine Park Biodiversity Expedition 2012; and (c) Johor 8 Islands Expedition 2016. Species denoted with an asterisk (*) are those considered to represent new records for the east coast of Peninsular Malaysia.

Order Scleractinia (17)	a	b	c	Abundance (sensu Veron, 2000)	IUCN Status
Family Acroporidae (79)					
<i>Acropora abrotanoides</i> (Lamarck, 1816)		/		Sometimes common	LC
<i>Acropora anthocercis</i> (Brook, 1893)			/	Sometimes common	VU
<i>Acropora aspera</i> (Dana, 1846)	/	/		Sometimes common	VU
<i>Acropora austera</i> (Dana, 1846)		/		Usually uncommon	NT
<i>Acropora cerealis</i> (Dana, 1846)	/		/	Common	LC
<i>Acropora clathrata</i> (Brook, 1891)		/	/	Common	LC
<i>Acropora cytherea</i> (Dana, 1846)	/	/	/	Common	LC
<i>Acropora digitifera</i> (Dana, 1846)	/	/	/	Sometimes common	NT
<i>Acropora divaricata</i> (Dana, 1846)	/	/	/	Common	NT
<i>Acropora florida</i> (Dana, 1846)	/	/	/	Common	NT
<i>Acropora gemmifera</i> (Brook, 1892)	/	/		Common	LC
<i>Acropora globiceps</i> (Dana, 1846)		/		Common	VU
<i>Acropora grandis</i> (Brook, 1892)		/		Common	LC
<i>Acropora hemprichii</i> (Ehrenberg, 1834)		/		Common	VU
<i>Acropora hoeksemai</i> Wallace, 1997	/	/	/	Common	VU
<i>Acropora horrida</i> (Dana, 1846)	/	/		Uncommon	VU
<i>Acropora humilis</i> (Dana, 1846)	/	/		Common	NT
<i>Acropora hyacinthus</i> (Dana, 1846)	/	/	/	Common	NT
<i>Acropora intermedia</i> (Brook, 1891)			/	Unknown	NE
<i>Acropora latistella</i> (Brook, 1892)	/	/	/	Common	LC
<i>Acropora loripes</i> (Brook, 1892)	/	/		Common	NT
<i>Acropora microphthalma</i> (Verrill, 1869)	/	/		Common	LC
<i>Acropora millepora</i> (Ehrenberg, 1834)	/	/	/	Common	NT
<i>Acropora monticulosa</i> (Brüggemann, 1879)	/	/		Uncommon	NT
<i>Acropora muricata</i> (Linnaeus, 1758)	/	/	/	Common	NT
<i>Acropora nasuta</i> (Dana, 1846)	/	/		Common	NT
* <i>Acropora pectinata</i> Veron, 2000		/		Uncommon	DD
<i>Acropora robusta</i> (Dana, 1846)	/	/		Common	LC
<i>Acropora samoensis</i> (Brook, 1891)	/	/		Usually uncommon	LC
<i>Acropora sarmentosa</i> (Brook, 1892)	/	/		Common	LC
<i>Acropora secale</i> (Studer, 1878)	/			Common	NT
<i>Acropora selago</i> (Studer, 1879)	/		/	Sometimes common	NT
<i>Acropora solitaryensis</i> Veron & Wallace, 1984	/	/		Rare	VU
<i>Acropora subulata</i> (Dana, 1846)		/		Common	LC
<i>Acropora tenuis</i> (Dana, 1846)	/			Common	NT
<i>Acropora valenciennesi</i> (Milne Edwards, 1860)		/		Common	LC
<i>Acropora valida</i> (Dana, 1846)	/			Sometimes common	LC
<i>Acropora vaughani</i> Wells, 1954		/		Uncommon	VU
<i>Acropora yongei</i> Veron & Wallace, 1984	/	/		Common	LC
<i>Alveopora daedalea</i> (Forskål, 1775)		/		Uncommon	VU
<i>Alveopora spongiosa</i> Dana, 1846			/	Usually uncommon	NT
<i>Anacropora forbesi</i> Ridley, 1884		/		Uncommon	LC
<i>Anacropora matthaii</i> Pillai, 1973	/			Rare	VU
* <i>Astreopora explanata</i> Veron, 1985			/	Sometimes common	NE
<i>Astreopora gracilis</i> Bernard, 1896			/	Sometimes common	LC
<i>Astreopora listeri</i> Bernard, 1896		/		Usually uncommon	LC
<i>Astreopora myriophthalma</i> (Lamarck, 1816)	/	/		Common	LC
<i>Astreopora ocellata</i> Bernard, 1896		/		Usually rare	LC
<i>Isopora brueggemanni</i> (Brook, 1893)	/	/		Common	VU
<i>Isopora cuneata</i> (Dana, 1846)		/		Common	VU
<i>Isopora palifera</i> (Lamarck, 1816)	/	/		Common	NT

Order Scleractinia (17)	a	b	c	Abundance (sensu Veron, 2000)	IUCN Status
<i>Montipora aequituberculata</i> Bernard, 1897	/	/	/	Common	LC
<i>Montipora cactus</i> Bernard, 1897		/		Common	VU
<i>Montipora caliculata</i> (Dana, 1846)		/		Uncommon	VU
<i>Montipora cebuensis</i> Nemenzo, 1976	/	/		Uncommon	VU
<i>Montipora confusa</i> Nemenzo, 1967		/		Uncommon	NT
<i>Montipora danae</i> Milne Edwards & Haime, 1851		/		Common	LC
<i>Montipora delicatula</i> Veron, 2000		/		Uncommon	VU
<i>Montipora digitata</i> (Dana, 1846)		/		Common	LC
<i>Montipora effusa</i> (Dana, 1846)		/		Uncommon	NT
<i>Montipora florida</i> Nemenzo, 1967		/		Common	VU
<i>Montipora foliosa</i> (Pallas, 1766)		/		Common	NT
<i>Montipora foveolata</i> (Dana, 1846)		/		Seldom common	NT
<i>Montipora gaimardi</i> Bernard, 1897	/	/		Sometimes common	VU
<i>Montipora hispida</i> (Dana, 1846)	/	/	/	Usually uncommon	LC
<i>Montipora informis</i> Bernard, 1897		/		Common	LC
<i>Montipora malampaya</i> Nemenzo, 1967	/			Common	VU
<i>Montipora mollis</i> Bernard, 1897	/	/		Common	LC
<i>Montipora monasteriata</i> (Forskål, 1775)		/		Common	LC
<i>Montipora nodosa</i> (Dana, 1846)		/		Usually uncommon	NT
<i>Montipora palawanensis</i> Veron, 2000		/		Uncommon	NT
<i>Montipora peltiformis</i> Bernard, 1897		/		Uncommon	NT
<i>Montipora stellata</i> Bernard, 1897		/		Common	LC
<i>Montipora tuberculosa</i> (Lamarck, 1816)	/	/		Common	LC
<i>Montipora turgescens</i> Bernard, 1897			/	Common	LC
<i>Montipora turtlensis</i> Veron & Wallace, 1984		/		Common	VU
<i>Montipora venosa</i> (Ehrenberg, 1834)		/		Uncommon	NT
<i>Montipora verrucosa</i> (Lamarck, 1816)		/		Sometimes common	LC
<i>Montipora verruculosa</i> Veron, 2000		/		Uncommon	VU
Famili Agariciidae (15)					
* <i>Coeloseris mayeri</i> Vaughan, 1918		/	/	Uncommon	LC
<i>Gardineroseris planulata</i> (Dana, 1846)	/	/		Usually uncommon	LC
<i>Leptoseris explanata</i> Yabe & Sugiyama, 1941	/	/		Uncommon	LC
<i>Leptoseris foliosa</i> Dinesen, 1980		/		Uncommon	LC
<i>Leptoseris hawaiiensis</i> Vaughan, 1907		/		Uncommon	LC
<i>Leptoseris mycetoseroides</i> Wells, 1954	/		/	Sometimes common	LC
<i>Leptoseris scabra</i> Vaughan, 1907		/		Usually uncommon	LC
<i>Pavona bipartita</i> Nemenzo, 1979	/			Uncommon	VU
<i>Pavona cactus</i> (Forskål, 1775)	/	/		Common	VU
<i>Pavona clavus</i> Dana, 1846			/	Common	LC
<i>Pavona danai</i> (Milne Edwards, 1860)		/		Uncommon	VU
<i>Pavona decussata</i> (Dana, 1846)	/	/	/	Common	VU
* <i>Pavona divaricata</i> Lamarck, 1816			/	Unknown	NE
<i>Pavona explanulata</i> (Lamarck, 1816)	/	/	/	Common	LC
<i>Pavona varians</i> Verrill, 1864	/			Common	LC
Famili Astrocoeniidae (3)					
<i>Palauastrea ramosa</i> Yabe & Sugiyama, 1941		/		Common	NT
<i>Stylocoeniella armata</i> (Ehrenberg, 1834)		/		Rare	LC
<i>Stylocoeniella guentheri</i> (Bassett-Smith, 1890)	/	/		Uncommon	LC
Famili Dendrophylliidae (10)					
<i>Duncanopsammia peltata</i> (Esper, 1790)	/	/	/	Common	VU
<i>Tubastraea coccinea</i> Lesson, 1830	/		/	Unknown	NE
<i>Tubastraea diaphana</i> (Dana, 1846)	/			Unknown	NE
<i>Tubastraea faulkneri</i> Wells, 1982			/	Unknown	NE
<i>Tubastraea micranthus</i> (Ehrenberg, 1834)	/		/	Unknown	NE
<i>Turbinaria frondens</i> (Dana, 1846)			/	Common	LC
<i>Turbinaria irregularis</i> Bernard, 1896	/			Common	LC
<i>Turbinaria mesenterina</i> (Lamarck, 1816)	/	/	/	Common	VU

Order Scleractinia (17)	a	b	c	Abundance (sensu Veron, 2000)	IUCN Status
<i>Turbinaria reniformis</i> Bernard, 1896	/	/	/	Sometimes common	VU
<i>Turbinaria stellulata</i> (Lamarck, 1816)	/	/	/	Usually uncommon	VU
Famili Diploastreidae (1)					
<i>Diploastrea heliopora</i> (Lamarck, 1816)	/	/	/	Common	NT
Famili Euphylliidae (8)					
<i>Euphyllia cristata</i> Chevalier, 1971	/	/	/	Uncommon	VU
<i>Euphyllia glabrescens</i> (Chamisso & Eysenhardt, 1821)	/	/	/	Uncommon	NT
<i>Euphyllia paraglabrescens</i> Veron, 1990	/	/	/	Rare	VU
<i>Fimbriaphyllia ancora</i> (Veron & Pichon, 1980)	/	/	/	Seldom common	VU
<i>Fimbriaphyllia divisa</i> (Veron & Pichon, 1980)	/	/	/	Seldom common	NT
<i>Fimbriaphyllia paradivisa</i> (Veron, 1990)	/	/	/	Uncommon	VU
<i>Galaxea astreata</i> (Lamarck, 1816)	/	/	/	Common	VU
<i>Galaxea fascicularis</i> (Linnaeus, 1767)	/	/	/	Uncommon	NT
Famili Fungiidae (20)					
<i>Ctenactis crassa</i> (Dana, 1846)	/	/	/	Usually uncommon	LC
<i>Ctenactis echinata</i> (Pallas, 1766)	/	/	/	Common	LC
<i>Cycloseris explanulata</i> (van der Horst, 1922)	/	/	/	Uncommon	LC
<i>Cycloseris vaughani</i> (Boschma, 1923)	/	/	/	Rare	LC
<i>Danafungia horrida</i> (Dana, 1846)	/	/	/	Uncommon	NE
<i>Danafungia scruposa</i> (Klunzinger, 1879)	/	/	/	Uncommon	LC
<i>Fungia fungites</i> (Linnaeus, 1758)	/	/	/	Common	NT
* <i>Halomitra pileus</i> (Linnaeus, 1758)	/	/	/	Usually uncommon	LC
<i>Heliopora actiniformis</i> (Quoy & Gaimard, 1833)	/	/	/	Common	VU
<i>Herpolitha limax</i> (Esper, 1792)	/	/	/	Common	LC
<i>Lithophyllon concinna</i> (Verrill, 1864)	/	/	/	Common	LC
<i>Lithophyllon repanda</i> (Dana, 1846)	/	/	/	Common	LC
<i>Lithophyllon undulatum</i> Rehberg, 1892	/	/	/	Usually uncommon	NT
<i>Lobactis scutaria</i> (Lamarck, 1801)	/	/	/	Common	LC
<i>Pleuractis granulosa</i> (Klunzinger, 1879)	/	/	/	Usually uncommon	LC
<i>Pleuractis moluccensis</i> (Van der Horst, 1919)	/	/	/	Usually uncommon	LC
<i>Pleuractis paumotensis</i> (Stutchbury, 1833)	/	/	/	Common	LC
<i>Podabacia crustacea</i> (Pallas, 1766)	/	/	/	Usually uncommon	LC
<i>Polyphyllia talpina</i> (Lamarck, 1801)	/	/	/	Common	LC
<i>Sandalolitha robusta</i> (Quelch, 1886)	/	/	/	Common	LC
Famili Lobophylliidae (23)					
<i>Acanthastrea echinata</i> (Dana, 1846)	/	/	/	Usually uncommon	LC
<i>Acanthastrea hemprichii</i> (Ehrenberg, 1834)	/	/	/	Uncommon	VU
<i>Acanthastrea pachysepta</i> (Chevalier, 1975)	/	/	/	Usually uncommon	NT
* <i>Acanthastrea rotundoflora</i> Chevalier, 1975	/	/	/	Usually uncommon	NT
<i>Cynarina lacrymalis</i> (Milne Edwards & Haime, 1848)	/	/	/	Seldom common	NT
<i>Echinophyllia aspera</i> (Ellis & Solander, 1786)	/	/	/	Rare	LC
<i>Echinophyllia glabra</i> (Nemanzo, 1959)	/	/	/	Common	LC
<i>Homophyllia australis</i> (Milne Edwards & Haime, 1848)	/	/	/	Uncommon	LC
<i>Lobophyllia agaricia</i> (Milne Edwards & Haime, 1849)	/	/	/	Uncommon	LC
<i>Lobophyllia corymbosa</i> (Forskål, 1775)	/	/	/	Sometimes common	LC
<i>Lobophyllia diminuta</i> Veron, 1985	/	/	/	Uncommon	VU
<i>Lobophyllia flabelliformis</i> Veron, 2000	/	/	/	Usually uncommon	VU
<i>Lobophyllia hataii</i> Yabe, Sugiyama & Eguchi, 1936	/	/	/	Uncommon	LC
<i>Lobophyllia hemprichii</i> (Ehrenberg, 1834)	/	/	/	Common	LC
<i>Lobophyllia radians</i> (Milne Edwards & Haime, 1849)	/	/	/	Common	LC
<i>Lobophyllia recta</i> (Dana, 1846)	/	/	/	Common	LC
<i>Lobophyllia robusta</i> Yabe & Sugiyama, 1936	/	/	/	Uncommon	LC
<i>Lobophyllia valenciennesii</i> (Milne Edwards & Haime, 1849)	/	/	/	Uncommon	LC
<i>Lobophyllia vitiensis</i> (Brüggemann, 1877)	/	/	/	Usually uncommon	NT
<i>Micromussa lordhowensis</i> (Veron & Pichon, 1982)	/	/	/	Sometimes common	NT
<i>Oxypora crassispinosa</i> Nemanzo, 1979	/	/	/	Uncommon	LC
<i>Oxypora echinata</i> (Saville Kent, 1871)	/	/	/	Usually rare	LC
<i>Oxypora lacera</i> (Verrill, 1864)	/	/	/	Common	LC

Order Scleractinia (17)	a	b	c	Abundance (sensu Veron, 2000)	IUCN Status
Famili Merulinidae (57)					
<i>Astraeosmilia tumida</i> (Matthai, 1928)	/	/		Uncommon	NT
<i>Astrea curta</i> Dana, 1846	/		/	Common	LC
<i>Coelastrea aspera</i> (Verrill, 1866)		/	/	Common	LC
<i>Cyphastrea microphthalma</i> (Lamarck, 1816)		/	/	Common	LC
<i>Cyphastrea ocellina</i> (Dana, 1846)		/		Rare	VU
<i>Cyphastrea serailia</i> (Forskål, 1775)			/	Common	LC
<i>Dipsastraea amicum</i> (Milne Edwards & Haime, 1849)	/			Uncommon	LC
<i>Dipsastraea favus</i> (Forskål, 1775)		/	/	Common	LC
<i>Dipsastraea helianthoides</i> (Wells, 1954)			/	Sometimes common	NT
<i>Dipsastraea maritima</i> (Nemenzo, 1971)	/			Uncommon	NT
<i>Dipsastraea pallida</i> (Dana, 1846)	/			Less common	LC
<i>Dipsastraea speciosa</i> (Dana, 1846)			/	Common	LC
<i>Dipsastraea veroni</i> (Moll & Best, 1984)		/	/	Rare	NT
<i>Echinopora gemmacea</i> (Lamarck, 1816)	/		/	Usually uncommon	LC
<i>Echinopora horrida</i> Dana, 1846		/	/	Uncommon	NT
<i>Echinopora lamellosa</i> (Esper, 1791)		/	/	Common	LC
<i>Echinopora mammiformis</i> (Nemenzo, 1959)		/	/	Common	NT
<i>Echinopora pacifica</i> Veron, 1990	/	/	/	Usually uncommon	NT
<i>Favites abdita</i> (Ellis & Solander, 1786)	/	/	/	Common	NT
<i>Favites complanata</i> (Ehrenberg, 1834)		/		Sometimes common	NT
<i>Favites flexuosa</i> (Dana, 1846)		/	/	Sometimes common	NT
<i>Favites halicora</i> (Ehrenberg, 1834)	/	/	/	Usually uncommon	NT
<i>Favites magnistellata</i> (Milne Edwards & Haime, 1849)	/		/	Usually uncommon	NT
<i>Favites melicerum</i> (Ehrenberg, 1834)		/		Rare	NT
<i>Favites pentagona</i> (Esper, 1790)		/	/	Sometimes common	LC
<i>Favites valenciennesii</i> (Milne Edwards & Haime, 1849)		/		Usually uncommon	NT
* <i>Favites vasta</i> (Klunzinger, 1879)			/	Uncommon	NT
<i>Goniastrea edwardsi</i> Chevalier, 1971	/	/		Common	LC
<i>Goniastrea favulus</i> (Dana, 1846)	/	/	/	Uncommon	NT
<i>Goniastrea pectinata</i> (Ehrenberg, 1834)	/	/	/	Common	LC
<i>Goniastrea retiformis</i> (Lamarck, 1816)		/	/	Common	LC
<i>Goniastrea stelligera</i> (Dana, 1846)	/	/	/	Common	NT
<i>Hydnophora exesa</i> (Pallas, 1766)	/	/	/	Common	NT
<i>Hydnophora grandis</i> Gardiner, 1904	/	/		Usually uncommon	LC
<i>Hydnophora microconos</i> (Lamarck, 1816)	/	/	/	Uncommon	NT
<i>Hydnophora rigida</i> (Dana, 1846)		/	/	Sometimes common	LC
<i>Leptoria phrygia</i> (Ellis & Solander, 1786)	/	/	/	Common	NT
<i>Merulina ampliata</i> (Ellis & Solander, 1786)	/	/	/	Usually common	LC
<i>Merulina cylindrica</i> (Milne Edwards & Haime, 1849)	/		/	Uncommon	LC
<i>Merulina scabricula</i> Dana, 1846	/	/		Common	LC
<i>Mycedium elephantotus</i> (Pallas, 1766)	/	/	/	Common	LC
<i>Orbicella annularis</i> (Ellis & Solander, 1786)		/		Rare	NE
<i>Oulophyllia bennettae</i> (Veron, Pichon & Wijsman-Best, 1977)	/	/		Uncommon	NT
<i>Oulophyllia crispa</i> (Lamarck, 1816)	/	/	/	Uncommon	NT
<i>Paramontastraea salebroso</i> (Nemenzo, 1959)		/		Rare	VU
* <i>Paramontastraea serageldini</i> (Veron, 2000)			/	Rare	VU
<i>Pectinia alcornis</i> (Saville Kent, 1871)		/	/	Usually uncommon	VU
<i>Pectinia lactuca</i> (Pallas, 1766)		/		Common	VU
<i>Pectinia maxima</i> (Moll & Best, 1984)		/		Uncommon	EN
<i>Pectinia paeonia</i> (Dana, 1846)	/	/	/	Common	NT
<i>Platygyra acuta</i> Veron, 2000		/		Sometimes common	NT
<i>Platygyra daedalea</i> (Ellis & Solander, 1786)	/		/	Common	LC
<i>Platygyra lamellina</i> (Ehrenberg, 1834)	/	/	/	Usually uncommon	NT
<i>Platygyra pini</i> Chevalier, 1975		/	/	Usually uncommon	LC
<i>Platygyra sinensis</i> (Milne Edwards & Haime, 1849)	/	/	/	Usually uncommon	LC

Order Scleractinia (17)	a	b	c	Abundance (sensu Veron, 2000)	IUCN Status
<i>Platygyra verweyi</i> Wijsman-Best, 1976	/			Usually uncommon	NT
<i>Trachyphyllia geoffroyi</i> (Audouin, 1826)	/			Rare	NT
Famili Plerogyridae (2)					
<i>Physogyra lichtensteini</i> (Milne Edwards & Haime, 1851)	/	/		Common	VU
<i>Plerogyra sinuosa</i> (Dana, 1846)	/	/	/	Usually uncommon	NT
Famili Plesiastreidae (1)					
<i>Plesiastrea versipora</i> (Lamarck, 1816)	/	/		Unknown	LC
Famili Pocilloporidae (7)					
<i>Pocillopora damicornis</i> (Linnaeus, 1758)	/	/	/	Common	LC
<i>Pocillopora grandis</i> Dana, 1846		/		Common	NT
<i>Pocillopora meandrina</i> Dana, 1846		/		*Common	LC
<i>Pocillopora verrucosa</i> (Ellis & Solander, 1786)	/	/		Common	LC
* <i>Seriatopora hystrix</i> Dana, 1846		/		Common	LC
<i>Stylophora pistillata</i> (Esper, 1792)		/		Common	NT
<i>Stylophora subseriata</i> (Ehrenberg, 1834)	/	/		Common	LC
Famili Poritidae (21)					
<i>Goniopora columna</i> Dana, 1846	/	/		Common	NT
<i>Goniopora djiboutiensis</i> Vaughan, 1907			/	Common	LC
* <i>Goniopora gracilis</i> (Milne Edwards & Haime, 1849)			/	Unknown	NE
<i>Goniopora lobata</i> Milne Edwards, 1860	/	/		Common	NT
<i>Goniopora norfolkensis</i> Veron & Pichon, 1982	/			Uncommon	LC
<i>Goniopora planulata</i> (Ehrenberg, 1834)	/			Usually uncommon	VU
<i>Goniopora stokesi</i> Milne Edwards & Haime, 1851	/			Uncommon	NT
<i>Porites annae</i> Crossland, 1952	/	/	/	Common	NT
<i>Porites attenuata</i> Nemenzo, 1955		/		Common	VU
<i>Porites australiensis</i> Vaughan, 1918		/		common	LC
<i>Porites cylindrica</i> Dana, 1846	/	/		Common	NT
<i>Porites densa</i> Vaughan, 1918		/		Sometimes common	NT
<i>Porites evermanni</i> Vaughan, 1907	/	/	/	Usually uncommon	DD
<i>Porites latistellata</i> Quelch, 1886		/		Uncommon	LC
<i>Porites lichen</i> (Dana, 1846)		/		Common	LC
<i>Porites lobata</i> Dana, 1846		/	/	Common	NT
<i>Porites lutea</i> Milne Edwards & Haime, 1851		/	/	Common	LC
<i>Porites monticulosa</i> Dana, 1846		/		Common	LC
<i>Porites nigrescens</i> Dana, 1846		/		Sometimes common	VU
<i>Porites rus</i> (Forskål, 1775)	/	/		Common	LC
<i>Porites solida</i> (Forskål, 1775)	/	/	/	Common	LC
Famili Psammocoridae (6)					
<i>Psammocora columna</i> Dana, 1846	/	/	/	Sometimes common	LC
<i>Psammocora contigua</i> (Esper, 1794)	/	/		Common	NT
<i>Psammocora digitata</i> Milne Edwards & Haime, 1851	/	/	/	Usually uncommon	NT
<i>Psammocora exesa</i> Dana, 1846	/	/		Common	LC
<i>Psammocora haimiana</i> Milne Edwards & Haime, 1851		/		Uncommon	LC
<i>Psammocora profundacella</i> Gardiner, 1898	/			Uncommon	LC
Famili Rhizangiidae (1)					
<i>Pseudosiderastrea tayamai</i> Yabe & Sugiyama, 1935	/			Uncommon	NT
Famili Leptastreidae (3)					
<i>Leptastrea aequalis</i> Veron, 2000	/			Rare	VU
<i>Leptastrea purpurea</i> (Dana, 1846)	/	/	/	Common	LC
<i>Leptastrea transversa</i> Klunzinger, 1879		/		Uncommon	LC
Famili Scleractinia incertae sedis (4)					
<i>Pachyseris foliosa</i> Veron, 1990	/			Uncommon	LC
<i>Pachyseris gemmae</i> Nemenzo, 1955	/	/		Rare	NT
<i>Pachyseris rugosa</i> (Lamarck, 1801)	/	/		Common	VU
<i>Pachyseris speciosa</i> (Dana, 1846)	/	/	/	Common	LC

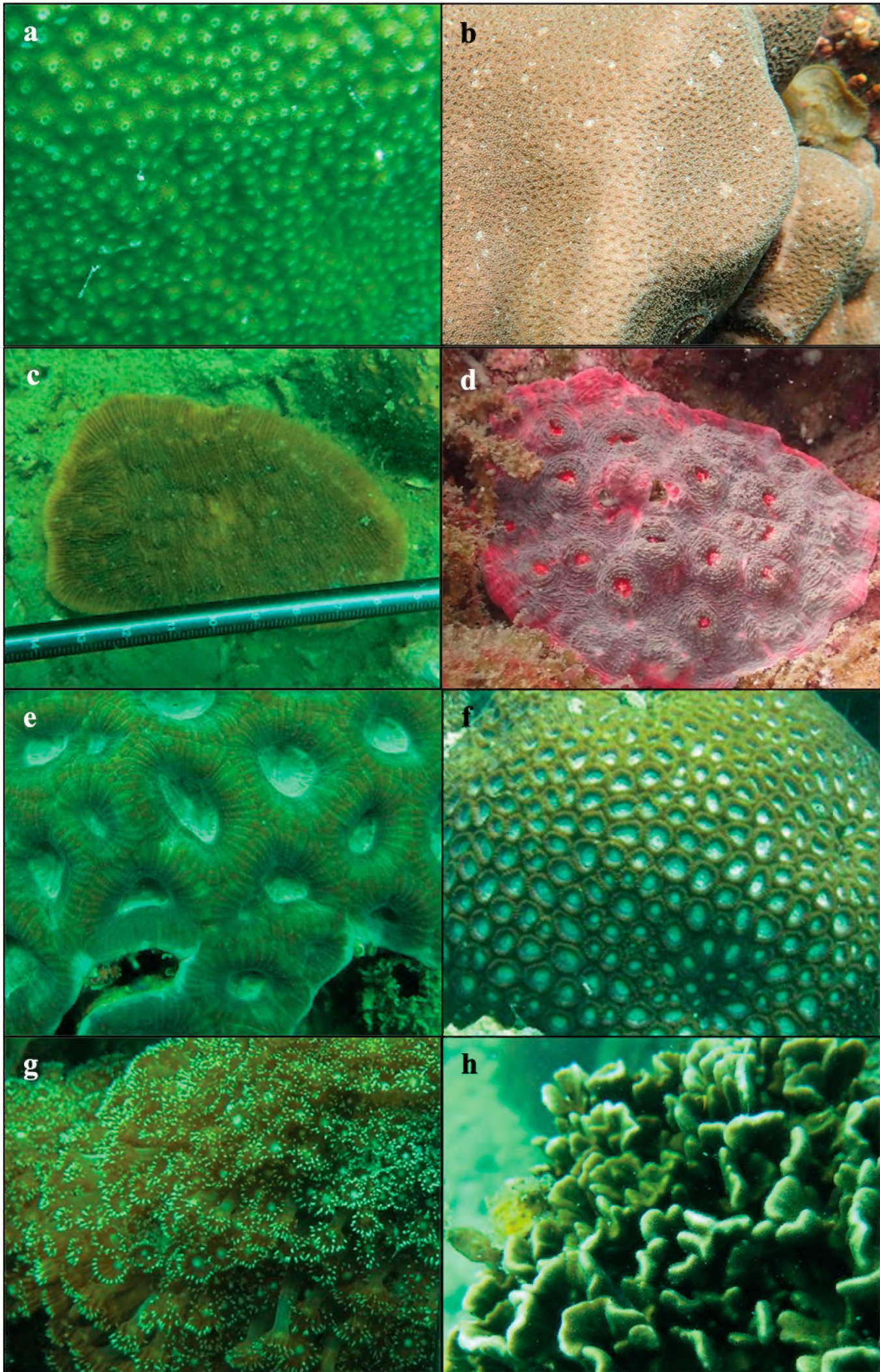


Figure 2. New records of scleractinian corals for the east coast of Peninsular Malaysia **a** *Astreopora explanata* **b** *Coeloseris mayeri* **c** *Halomitra pileus* **d** *Acanthastrea rotundoflora* **e** *Favites vasta* **f** *Paramontastraea serageldini* **g** *Goniopora gracilis*, and **h** *Pavona divaricata*.

Discussions and conclusions

The current study provides an updated species checklist of scleractinian corals from coral reefs around the Mersing Islands. A total of 261 scleractinian species were recorded, including ten new records for the east coast of Peninsular Malaysia, from where 398 species were previously reported (Huang et al. 2015). Compared to previous findings by Harborne et al. (2000) (155 species recorded from a subset of reefs around the Mersing Islands), we find the coral diversity around the Mersing Islands to be comparable, if not slightly higher, than other reefs in the region, i.e., Pulau Tioman with 239 species (Akmal et al. 2019) (i.e., north of the Mersing Islands) and Singapore with 255 species (Huang et al. 2009) (i.e., south of the Mersing Islands). The South China Sea in the Central Indo Pacific holds a high biodiversity of scleractinian corals, with a total recorded number of 571 species. The diversity found around the Mersing Islands represents ~ 45% of the total recorded coral fauna of the South China Sea and ~65% of the total recorded fauna from the east coast of Peninsular Malaysia. Previous records and records from the current study account for a total of 413 scleractinian coral species for reefs along the east coast of Peninsular Malaysia. These include eight new records of coral species at Pulau Tioman and Pulau Redang by Akmal et al. (2019) and the ten (10) new records from this study.

The ten new records of coral species for the east coast of Peninsular Malaysia found during this study are known to be widely distributed in the Indo-West Pacific Ocean (east coast of Africa to Japan and Melanesia) (Veron 2000; Cairns and Hoeksema 2022; GBIF 2022). Two of these species (*Acanthastrea rotundoflora* and *Seriatopora hystrix*) had previously been reported from Singapore's southern islands (Huang et al. 2009), whereas another species (*Pavona divaricata*) was previously recorded from the west coast of Peninsular Malaysia (Affendi and Rosman 2011). However, we note that all the newly recorded coral species found were rarely observed in our surveys, suggesting that their occurrence along the east coast of Peninsular Malaysia may be relatively low. Given the vastness of the coral reef area around the Mersing Islands and the complexity of reef ecosystems, together with seagrass meadows, such as those at Pulau Tinggi (Ooi et al. 2011) and Pulau Besar (Lee et al. 2010), we posit that the current account of coral diversity in this region may yet be underestimated. Further surveys around the Mersing Islands are likely to yield new findings, as visual surveys have only been conducted once at each study reef site. Although hard scleractinian corals form the basis of coral reef ecosystems, information about other reef-related species' diversity and abundance is also crucial for marine area planning (e.g., determining management strategies and protection status). Based on the results of the current study, we propose that more surveys should be conducted around the Mersing Islands, extending investigations to other taxa where possible.

Biodiversity and taxonomic studies on the scleractinian corals of Peninsular Malaysia are in their infancy compared to neighbouring regions, e.g., Singapore (Huang et al. 2009) and Sabah, East Malaysia (Waheed and Hoeksema 2013, 2014; Waheed et al. 2015). Given recent findings around the region, such as the new genus and

species records of *Micromussa analusensis* by Ng et al. (2019), the increased occurrence and records of *Pocillopora acuta* (Poquita-Du et al. 2017; Torres and Ravago-Gotanco 2018), and the cryptic speciation in *Pachyseris speciosa* (Bongaerts et al. 2021; Feldman et al. 2021), we can expect important scleractinian discoveries for the Mersing Islands (and other coral reefs in Malaysia) should we aim to further explore and examine these underexplored reefs.

Acknowledgements

We thank the Department of Fisheries Malaysia (formally known as Department of Marine Park Malaysia during both expeditions); EKOMAR from Universiti Kebangsaan Malaysia; and Institute of Biological Sciences and Team Sea Habitats from Universiti Malaya for organizing the expeditions. This study was supported by the Department of Fisheries Malaysia. We also express our special thanks to the reviewers and academic editor, who provided comments that helped improve the manuscript.

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